(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 May 2004 (13.05.2004)

PCT

(10) International Publication Number
WO 2004/040941 A1

(51) International Patent Classification[7]: H04R 5/033

(21) International Application Number:
PCT/HR2003/000055

(22) International Filing Date: 29 October 2003 (29.10.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
P20020861A 31 October 2002 (31.10.2002) HR

(71) Applicant and
(72) Inventor: MILNERSIC, Sinisa [HR/HR]; Pionirska 3, 51000 Rijeka (HR).

(74) Agent: INOVA D.O.O.; TRG Zrtava Fasizma 14, 10000 Zagreb (HR).

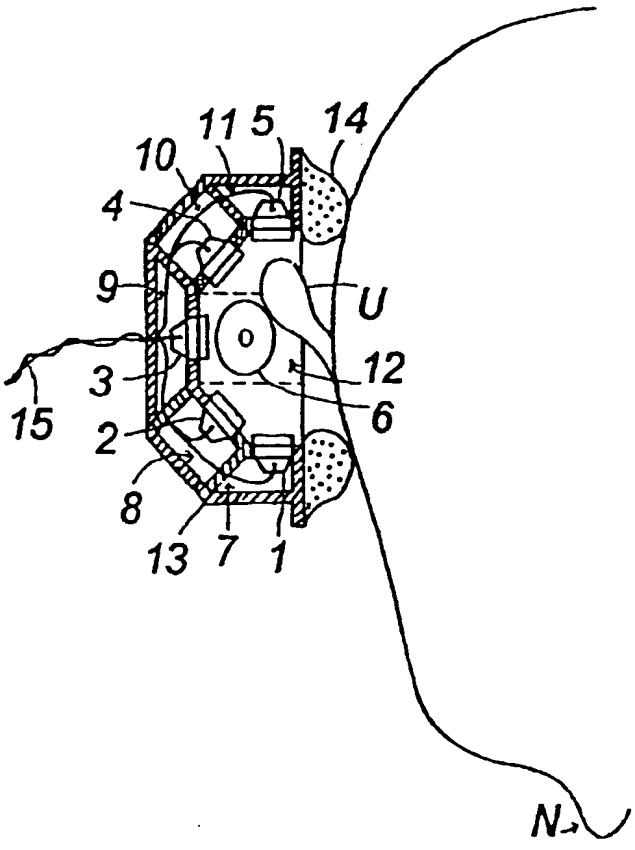
(81) Designated States *(national)*: AT, AU, BR, CA, CH, CN, DE, DK, ES, FI, GB, HU, ID, JP, KP, KR, LU, MX, NO, NZ, PH, RU, SE, SG, TR, US.

(84) Designated States *(regional)*: European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MULTICHANNEL HEADPHONES



(57) Abstract: The multichannel headphones serve for high-quality reproduction of three-dimensional sound at home, with the ability to adjust the volume at a comfortable level. The multichannel headphones comprise 6 small loudspeakers (Type 1), namely 16, 21, 26 or more small loudspeakers (Type 2) that are built-in each earphone, individual reproducing sound channels that each have their own air chambers (7-12), a plastic housing (13), cylindrical sponge (14) padded earcups that rest on the ears, as well as a cord (15) that embodies all of the loudspeakers' outputs. All of the aforementioned leads to the invention of universal headphones that are compatible with all multichannel sound systems and thus can be used for enjoying realistic three dimensional sounds from various audio sources.

WO 2004/040941 A1

MULTICHANNEL HEADPHONES

1. FIELD OF THE INVENTION

The present invention relates to multichannel headphones consisting of six (6) small loudspeakers (Type 1), namely sixteen (16) or more small loudspeakers (Type 2) that are fitted into each earphone. According to the International Patent Classification (IPC) this invention is classified under H04R1 – loudspeakers, microphones, gramophone pick-ups or like acoustic electromechanical tansducers, specifically H04R1/10 - earpieces.

2. TECHNICAL PROBLEMS

Lately we are witnesses of technical advances in the field of multimedia in general and especially in the audio and video techniques. One of the multimedia components is the three-dimensional (3D) sound system which aim is to deliver natural sound images to the listener. The delivery of the natural sound sensation to the listener is achieved through several separate sound channels. The 3D sound is especially important for DVD and VHS home theatre systems, high resolution televisions, PC games, game consoles as well as for a myriad of multimedia systems that will be devised in the future. Since the development and evolution of the multichannel sound proceeded gradually, it resulted in the rise of many multisound reproduction standards/systems. Up until now, there were no difficulties in meeting the different reproduction standards, since multichannel sound was reproduced through loudspeakers. The challenge was to devise headphones that can reproduce high quality multichannel sound from the majority of the registered standardized sound sources, such as: 2.0 (Stereo), 4.0 (Dolby Surround), 5.0 (Dolby Pro-Logic Surround), 5.1 (Dolby Digital Surround and DTS), 6.1 (DTS-ES and THX-EX), 7.1 (THX-EX). It is also very hard to devise headphones that can reproduce sounds coming from above or below the user ("vertical surround sound").

3. DESCRIPTION OF THE PRIOR ART

Currently, there are no known single solutions to the above described problem. There are similar solutions (patents JP63318900 and JP1314098), but the offered headphones have a maximum of two built-in loudspeakers in each earphone. These headphones can reproduce sound only from certain, above mentioned, standardized sound sources. In certain cases, digital signal processing techniques were used to create the 3D sound, but to no avail, since the sound that was

reproduced sounded artificial, thus the headphones could not be used for realistically conveying the sound of a live performance event, but only for computer games. As far as reproducing "vertical surround sound" for which Type 2 earphones are used, presently there is no solution offered.

4. SUMMARY OF THE INVENTION

The primary aim of this invention is to devise universal headphones that deliver a natural three-dimensional sensation and that are compatible with all known multichannel sound standards (Type 1) as well as universal headphones that in addition reproduce 3D vertical surround sound (Type 2).

The secondary aim of this invention is to devise universal headphones that can reproduce sounds from as many as possible multimedia systems.

Further, another object of the present invention is to devise headphones for privately enjoying realistic 3D sounds. A headphone system capable of being listened to by a person in private, at home, with the ability to adjust the volume at a comfortable level.

The headphones in this invention consist of 6 small loudspeakers (Type 1), namely 16 or more loudspeakers (Type 2) that are built-in each earphone, individual reproducing sound channels that each have their own air chambers, a plastic housing that connects all the chambers, cylindrical sponge padded earcups that rest on the ears, as well as a multi-wire cord that connects the earphones to the audio amplifier. All the loudspeakers have separate electric outputs. The loudspeakers are connected to the audio amplifier with corresponding couplings in order to reproduce a 3D sound of a certain standard/system.

5. SHORT DESCRIPTION OF THE DRAWINGS

Figure 1 shows the top view of the right headphone. The letter N for nose shows the direction the head is facing. This figure shows the Type 1 earphone.

Figure 2 shows the spatial view of the Type 1 right earphone with the corresponding loudspeakers and other earphone components.

Figure 3 shows the spatial view of the Type 2 right earphone with 16 corresponding loudspeakers as well as all the other earphone components.

6) DETAILED DESCRIPTION OF AT LEAST ONE OF THE PREFERRED EMBODIMENT

As seen in Figure 1, the Type 1 right earphone consists of 6 loudspeakers 1, 2, 3, 4, 5 and 6. Loudspeakers 1, 2, 3, 4, and 5 are identical and cover a wide range of frequencies. Together with the corresponding air chambers, these loudspeakers are aligned with the ear opening (U), and are arranged symmetrically in the direction of the ear opening. The sixth loudspeaker is slightly larger and it is a low-frequency loudspeaker. Its position is of no critical importance. It can be placed anywhere within the earphone housing (13). Right and left earphone speakers 1 represent the central loudspeakers for the 3D sound. Right and left earphone speakers 2 represent the front right namely front left speakers for the 3D sound. Right and left earphone speakers 3 represent the right surround, namely left surround loudspeakers. Right and left earphone speakers 5 represent the right rear, namely left rear surround loudspeakers. Right and left earphone speakers 4 are not intended for reproducing present 3D sounds but are reserved for future systems. Right and left earphone loudspeakers 6 represent the low-frequency speakers – subwoofer.

Figure 2 shows the dome-shaped earphone housing that has thick and hollow walls, which serve as air chambers for the loudspeakers. Each loudspeaker has its own air chamber. The air chambers are marked in Figure 1 as 7, 8, 9, 10, 11 and 12.

The structure of the Type 2 earphone is similar to the Type 1 earphone except that here instead of a single line of loudspeakers there are three stacks of loudspeakers. Instead of loudspeaker 1 there are loudspeakers 1A, 1B, 1C with corresponding three chambers. The same is with loudspeakers 2, 3, 4 and 5. Instead of loudspeakers 2, 3, 4 and 5 there are loudspeakers 2A, 2B, 2C, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B and 5C. There is still only one loudspeaker 6 and thus there are altogether 16 loudspeakers. This arrangement of the loudspeakers enables all combinations as in the Type 1 earphone, except that here the reproduction of the "vertical" 3D sound can be achieved, e.g. we can actually hear an airplane descending and landing on the runway. The Figure shows an earphone with loudspeakers stacked in three rows. However, earphones with 4, 5 and more rows of loudspeakers can be made in which case the reproduction of the 3D sound would be even more realistic. In such case, the total number of loudspeakers would be 21, 26 or more.

All Type 1 and Type 2 earphones have their own electric outputs that are coupled to the audio amplifier channels by means of a multi-wire cord (15).

In order to avoid getting a distorted sound and a distorted sound image, a cylindrical sponge pad 14 (Figure 1) is placed between the earphone housing and the head. The sponge pads are not shown in Figure 2 in order to get a better view of the other details.

The headband portion (Figure 2) is used for connecting the left and right earphones. A self-adjusting headband mechanism that ensures a personalized fit can be added.

7. INVENTION APPLICATION

The present invention is a practical and useful audio apparatus, which may be easily and efficiently manufactured and marketed. It includes significant improvements as compared to the existing versions. The invention may readily be utilized because of its universal quality, namely it can be used in combination with more than one audio source and it can replace almost all of the currently known similar headphone apparatuses. Simple changes and modifications, i.e. including more speakers make it possible for this apparatus to support potential future 3D sound systems.

CLAIMS

What is claimed is:

1. Multichannel headphones consisting of several small loudspeakers for each ear, each having separate sound channels with their own air chambers, a plastic housing that connects all the chambers, cylindrical sponge pads that are fitted to the ears, a metal headband that connects both earphones, and a multi-wire cord that connects the earphones to the audio amplifier, wherein each earphone has 6 built-in small loudspeakers (Type 1.)

2. Multichannel headphones consisting of several small loudspeakers for each ear, each having separate sound channels with their own air chambers, a plastic housing that connects all the chambers, cylindrical sponge pads that are fitted to the ears, a metal headband that connects both earphones, and a multi-wire cord that connects the earphones to the audio amplifier, wherein each earphone has 16, 21, 26 or more built-in small loudspeakers (Type 2.)

3. The multichannel headphones of claim 1, wherein each of the 6 speakers have separate outputs that make them compatible with all known 3D sound systems.

4. The multichannel headphones of claim 2, wherein each of the 16, 21, 26 or more loudspeakers have separate outputs that make them compatible with all known 3D sound systems.

FIG. 1

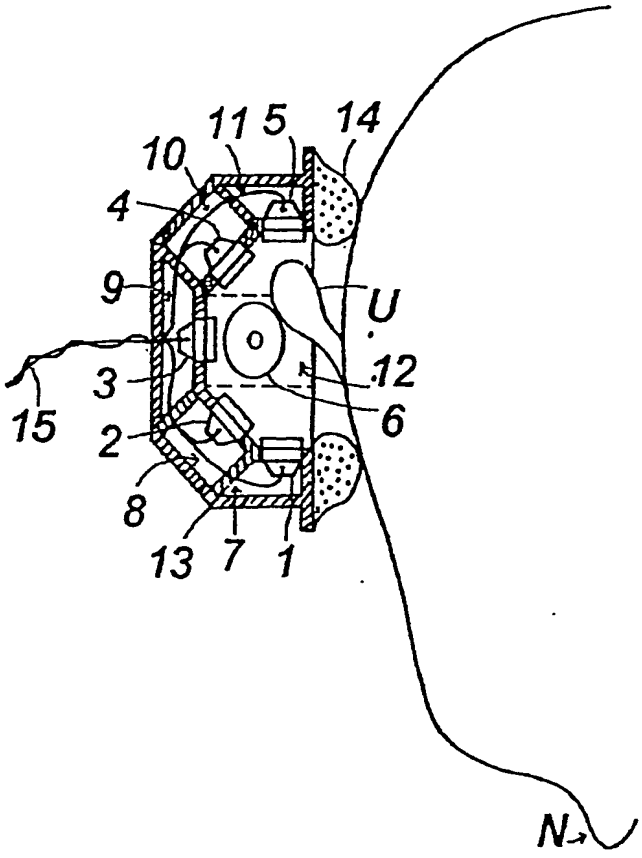


FIG. 2

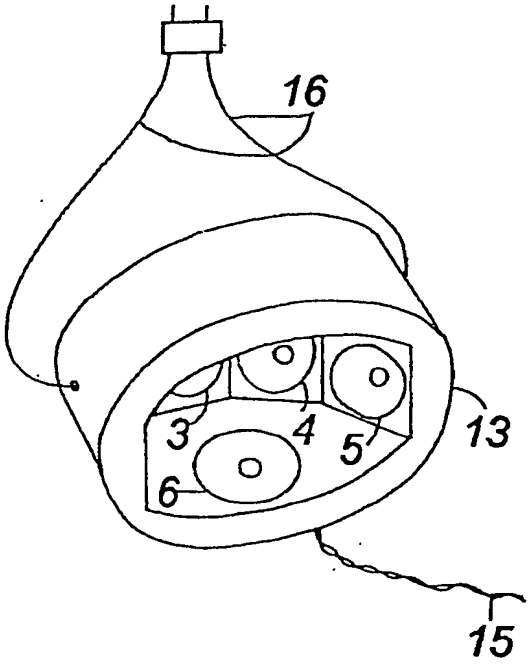
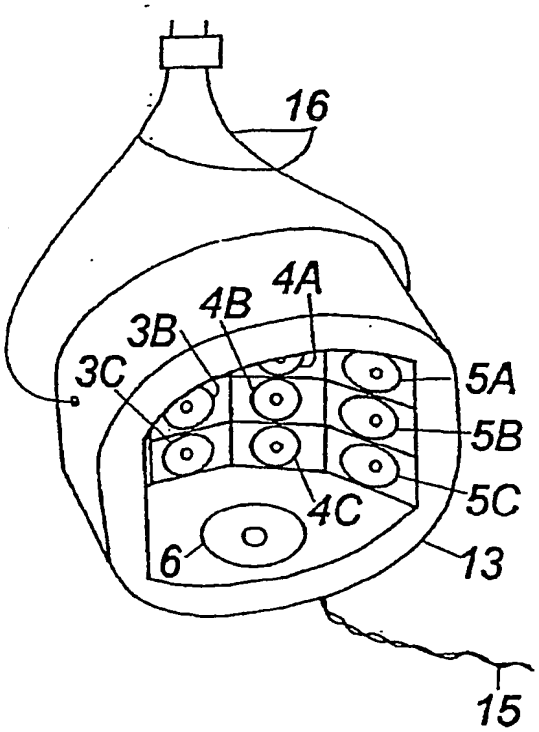


FIG. 3



INTERNATIONAL SEARCH REPORT

International Application No
PCT/HR 03/00055

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04R5/033

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04R H04S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 038 330 A (MEUCCI JR ROBERT JAMES) 14 March 2000 (2000-03-14) column 1, line 62 -column 2, line 24 column 5, line 53 -column 11, line 10; claims 1,10,11; figures 1-6	1-4
X	US 6 263 085 B1 (WEFFER SERGIO W) 17 July 2001 (2001-07-17) column 3, line 43 -column 4, line 61; figures 1-4	1-4
X	PATENT ABSTRACTS OF JAPAN vol. 018, no. 167 (E-1528), 22 March 1994 (1994-03-22) & JP 05 336599 A (FUJITSU LTD), 17 December 1993 (1993-12-17) abstract	1-4

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 February 2004	19/02/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Kunzelmann, C

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/HR 03/00055

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 684 879 A (VERDICK MICHAEL) 4 November 1997 (1997-11-04) column 3, line 30 - line 67; figures 1-3,5	1,2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/HR 03/00055

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6038330 A	14-03-2000	NONE	
US 6263085 B1	17-07-2001	NONE	
JP 05336599 A	17-12-1993	NONE	
US 5684879 A	04-11-1997	NONE	